Track Scales
Delaware, Lackawanna & Western Railroad
Scranton
Lackawanna County
Pennsylvania

HAER No. PA-132C

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Historic American Engineering Record
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# HISTORIC AMERICAN ENGINEERING RECORD

## Delaware, Lackawanna & Western Railroad: Scranton Yards: Track Scales

HAER NO. PA-132C

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|---|---|
| LOCATION: | 500 feet southeast of Bridge 60<br>Scranton, Lackawanna County, Pennsylvania<br><br>UTM: 18/443875/458424<br>QUAD: Scranton |
| DATE OF CONSTRUCTION: | 1926 |
| CONTRACTOR: | Delaware, Lackawanna & Western Railroad |
| PRESENT OWNER: | City of Scranton |
| PRESENT USE: | Not in use. |
| SIGNIFICANCE: | The D,L & W scale was made by the Fairbanks Company, one of the oldest manufacturers of platform scale in the United States. |
| HISTORIAN: | Kathryn Steen<br>Delaware, Lackawanna & Western Railroad: Scranton Yards Recording Project, 1989 |

## INTRODUCTION

In the late nineteenth and early twentieth centuries, the railroads in the United States played an integral role in the nation's commerce. As part of their function as common carriers, the railroads weighed and recorded the quantity of goods they carried to determine the fee for shipping. The weighing was accomplished in part by the use of track scales that would weigh an entire railroad car and its cargo. Generally the 50- to 60-foot scale was placed in a pit and the railroad cars rode on tracks crossing over the scale platform. The Delaware, Lackawanna and Western, like other railroads, was the operator of several track scales, including a 50-foot, 167-ton scale manufactured by the Fairbanks Company and installed in the Scranton, Pennsylvania yards in 1926.

## GOVERNMENT INVESTIGATION

Despite the seeming importance of accurately weighing goods, most railroads prior to 1900 were uninterested in upgrading poor weighing facilities. The late nineteenth-century popular uprising against railroad rate-setting practices forced no reforms or regulations in weighing methods. Decaying wooden parts, flagrant inaccuracies, and litigation claims were not uncommon.[1] Just after the turn of the century, in the heart of the Progressive reform movement, public agitation prompted a government investigation and consequently, railroads were forced to improve their scales and methods. The investigation, conducted by the Interstate Commerce Commission in 1912, revealed a host of inadequacies. The I.C.C. report showed that three-quarters of the scales were "of defective design or improperly installed," less that one-quarter were "properly inspected," and less than a tenth were "accurately tested." Weighing methods were sloppy; most of the figures written on the side of railroad cars, indicating weights when empty, were wrong.[2]

This scathing report of the muckraking era prompted responses from two groups of people. First, state legislators passed laws requiring frequent inspections.[3] Second, officials within the railroad industry reacted to the revelations of improper scale practices. Certainly the officials wanted to avoid any further public outcry, particularly among those members of the public who were their main customers. There were others in the railroad industry who argued for scale improvements on the basis of efficiency. What was the point, they argued, in requiring such close governmental, public, and railroad scrutiny of rates when the weights on which those rates were based were faulty?[4] In addition, news got out among railroaders that worn-out scales tended to weigh light and short-change the railroads, though the shipping customers never believed it.[5] In 1913, the industry organization, the

American Railway Association, issued a guide book on scales for the railroad companies. The ARA's Track Scale Specifications and Rules contained recommendations on every aspect of weighing, including construction, yard location, and maintenance.[6] Improvements included eliminating wooden parts, and installing waterproof cement pits with heat and ventilation.[7]

The railroad companies learned to accept the new requirements, although one contemporary journal article indicated that the acceptance was not complete through all ranks: the author suggested that general managers, superintendents and yardmasters would all find accurate scale measurements useful; the claims department enjoyed having the printed evidence from accurate, government-inspected scales to fend off litigation from shippers contesting the weights. Switchmen, conductors, and brakemen, on the other hand, generally thought of scales as a nuisance, while the commercial department found that accurate scales forced them to honesty and the department could no longer offer special, rate-avoiding deals to "certain industries whose business they are anxious to get away from competing lines."[8]

## LOCATION

Another piece of legislation, the Hepburn Act of 1906, had placed the responsibility of weighing at the freight's point of origin.[9] Consequently, some track scales received a heavier flow of traffic than others. The number of cars that needed to be weighed at any given point influenced the location of the scale within a yard or at other shipment-loading locations. In some yards, particularly classification yards where cars were sorted and trains assembled, a fairly large percentage of cars required weighing. In these cases, the scale would be located closer to the "hump," if there was one, and to the main thoroughfares in the yards. In yards where less freight was loaded onto the trains, the scale was kept further away from heavy traffic areas as unnecessary traffic across the scale wore down the bearings and pivots.[10]

## OPERATION

If a car needed to be weighed at Scranton, a locomotive would pull or push the car to the proper tracks. There were switches to direct a train to the scale tracks and more switches about 70 feet on either side of the scale platform. The second set of switches controlled which cars ran on the rails that crossed the scale mechanism--the "live" tracks--and which cars crossed on a duplicate set of rails that was not connected to the scale. These parallel "dead" tracks extended the longevity of the scale by bearing the weight of locomotives and cars that required no weighing.[11]

The Scranton scale was a 50-foot scale with a capacity of 167 tons.[12] By the late 1920s, scales typically came in standardized lengths of 50, 56, and 60 feet.[13] The 1926 scale replaced an earlier

42-foot, 100-ton scale in Scranton.[14] The trend toward larger and heavier rolling stock was probably a factor in the switch. The scale typically had to be of sufficient length to accommodate the largest car that would use the scales.[15] In the case of the Scranton scale, the cars were stopped on the scale, or "spot weighed." Elsewhere it was not uncommon for cars to be weighed while in motion, but that required a scale longer than Scranton's 50 feet.[16]

## SCALE MECHANISM

Essentially a track scale consisted of a rigid I-beam platform attached to a series of levers that reduced the load to a force sufficiently small to be countered by a rather light weight on the graduated weighbeam at the point of measurement. The entire mechanism, with the exception of the weighbeam, was located below ground level in a pit.

Beneath the "live" rails were the I-beams. The beams ran the entire length and width of the pit and were cross-braced to form a rigid, rectangular "bridge" that distributed the load evenly over the entire scale. From the bridge, the load was transmitted to four pairs of main levers (making the Scranton scale a typical "four-section" scale) that were perpendicular to the track. The main levers then transferred the load through four extension levers parallel to the track. From the extension levers the force was shifted to a transverse lever which extended out perpendicular to the tracks. The force then travelled up a narrow steelyard rod, to a shelf lever located just under the floor of the scale house, and then up a beam rod to the weighbeam inside the house.

The scale mechanism worked on the basis of levers. A lever has three parts: the fulcrum, the load point and the power point. In a normal, or "first-order" lever, the load is at one end, the power or counterbalancing force is at the other end, and the fulcrum is between the load and the power points. The distance between the point of power and the fulcrum is called the "power arm;" likewise, the distance between the load and the fulcrum is the "load arm." The closer the fulcrum is to the load--making the power arm longer and the load arm shorter--the less the power necessary to put the lever in a balance position, or state of equilibrium. This is the "multiplication effect" of levers, which is typically expressed as a ratio such as 3:1. A 3:1 ratio means the power arm is three times the length of the load arm. When levers are in a series, as they are in track scales, the multiplier of the series is the product of all the individual levers' multipliers. For example, if two levers, one with a ratio of 3:1 and the other 4:1 were attached, the series' ratio would be 12:1.[17]

In a track scale, the levers are not "first-order," but "second-order." The principle is basically the same, but the three main parts are in a different order. In these levers, the fulcrum is at one end, the power point at the other end, and the load falls in the middle. The definition of "power arm" and "load arm" and the ratio between them remains the same. Also, in terms of thinking of the track scale, the point of view is not from the power point, but from the load; consequently one speaks of the levers' "reducing effect" instead of the multiplication effect.[18]

When a railroad car was on the live rails, the load was initially borne by the bridge. Attached under the bridge were eight leg-like bearings that became the load point in the main levers. The fulcrums in the main levers faced the pit walls. At three points on a main lever (the fulcrum, load, and power points) there were "knife-edges," or bar-like pivots. Because of the wear and tear at these connections, knife-edges were typically made out of hard steel alloys. The load point connection was arranged in what was called a suspended bearing. Instead of the bearing sitting directly on top of the load point knife-edge, it extended below the knife-edge, suspended by means of a loop-like connection.[19] The power point for each main lever was in a vertical line with the power point of the opposite main lever.

From the main levers, the load was transferred to the four extension levers. The two sets of outside main levers attached to the end extension levers and the inside sets of main levers attached to the center extension levers. The end extension levers were second order levers like the main levers. The fulcrum knife-edge was on the end of the lever nearest the wall, the load point was at the connection with the main levers, and the power point was the end of the lever that attached to the center extension lever. The pivot between the two extension levers was known as a "nose iron." If the load was not distributing over the scale equally or some adjustment for accuracy was necessary, the nose iron could be loosened and slid back and forth to change the effective lengths of the levers.[20]

The center extension levers receive the load from the end extension levers and their own set of main levers. These in turn transmit the force to a transverse lever that is perpendicular to the four extension levers. Sometimes called the "fifth" lever, the transverse lever extended from beneath the scale platform to a point directly under the weighbeam in the scale house. The main levers, the extension levers and the transverse lever are all extant in the D,L & W scale. The rest of the mechanism is missing, but since the scale is in most respects typical, reasonable guesses can be hazarded as to the absent components. From the transverse lever, there would have been a vertical steelyard rod rising to just under the scale house floor. At this point, the rod was probably attached to a shelf lever. This smaller lever would have had its fulcrum attached to the underside of the cement slab in the floor of the scale house. From the shelf lever, another rod--the beam rod--would have extended up to the weighbeam where the measurements were taken. It is possible that there was no shelf lever, in which case there would have been no steelyard rod and the beam rod would have spanned the distance between the transverse lever and the weighbeam.[21] There were probably two bars on the weighbeam, a main bar and a fractional bar.[22]

In the scale house, the weighbeam would have been the center of activity for the scale operators. The weighbeam itself was a lever and had graduated bars along which small counterweights, or "poises" slid. The series of levers sufficiently reduced the load so that a counterweight of about 25 pounds could offset the weight of a railroad car. The ratios of reduction for the Scranton scales are unknown, but one example of a set of ratios for a 300,000 pound capacity scale might suggest what the approximate reductions in the Scranton scale were. In the example, the main levers reduce 5:1, the extension levers 8-1/3 : 1, the transverse lever 3-3/5 : 1, the shelf lever 5:1 and the weighbeam 16:1. The entire series made for a total reduction of 12,000:1.[23]

When a car was on the scale track, the scale operator moved the counterweights on the weighbeam until the weighbeam was in equilibrium. Then, using the graduated rule on the bar, the operator could see how much the railroad car weighed. Standard ARA practice recommended the use of a type registering mechanism to record the weights on a card.[24] The counterweight or poise might have had a type wheel that revolved as the weight moved along the weighbeam bars. An alternative was to have the raised numbers directly on the bars. The card, or ticket, was placed in a slot on the poise, and a movement of a hand lever imprinted the weight of the car on the card.[25] The operator was responsible for recording the car number and the car's empty weight which were both painted on the side of the cars. The tickets were then sent to the accounting department where they figured out the weights and the corresponding rates to charge to the shippers.[26]

## SCALE HOUSE AND PIT

The scale house is a simple wooden frame building whose sole function was to protect the weighbeam from the weather.[27] The weighbeam apparatus was supported on a concrete slab, but the rest of the floor was wood planking over the pit. It was important to have windows that gave the operator a good view of the car he was weighing.[28]

While the accommodations for the scale operator were minimal, the scale itself was adequately protected by the scale pit, which seemed to be up to ARA standards. The cement pit with heating and ventilation helped to guard against debilitating rust. There was a stove in the pit from which a flue rose through the scale house. It is probable that the pit and house were equipped with electric lights. The pit was large enough to allow easy maintenance. Access to the pit was through a trapdoor in the scale house.[29]

## FAIRBANKS COMPANY

The D,L & W Scranton scale was manufactured by the Fairbanks Company, an old name in platform scales. In 1831, the Fairbanks Brothers patented a wagon scale. Twenty-six years later, Thaddeus Fairbanks patented a "four-section iron frame track scale embodying the essential principle" in the Scranton scale. Scales gradually grew in capacity and strength of materials, and the designers started to take engineering principles into consideration.[30]

## INSPECTION

Just after the 1912 Interstate Commerce Commission investigation, there was a Congressional appropriation for a government test car for use in inspecting railroad scales. The car came with portable weights that the government inspectors would vary when testing the scales.[31] The I.C.C. required the scales to be accurate within 100 pounds.[32] With the government policing the scales, the railroads had an incentive to practice proper maintenance and inspection themselves. ARA specifications from 1919 recommended testing the car at least every three months.[33] Ten years later, "good practice" dictated inspecting the scales every two weeks, because, as the railroaders had gradually accepted, "the revenue derived from the transportation of the freight depends directly on the accuracy of the weights obtained."[34]

# NOTES

1.Herbert T. Wade, "Railway Track Scales and Car-Load Weighing," The Engineering Magazine (June 1914), 396.

2.Herbert T. Wade, "Railway Track Scales and Weighing Methods," The Engineering Magazine (May 1914), 220.

3.Wade, "Railway Track," (May 1914), 219.

4.Wade, "Railway Track," (May 1914), 215-6.

5.Herbert T. Wade, Scales and Weighing: Their Industrial Applications (New York: The Ronald Press Company, 1924), 408.

6.Wade, "Railway Track," (May 1914), 220.

7.Wade, Scales, 409-10.

8.F.S. Elliott, "Some Different Opinions on Scales," The Scale Journal, Vol. 1 (January 25, 1915), 15.

9.Wade, Scales, 408.

10.John A. Droege, Freight Terminals and Trains, second edition (New York: McGraw-Hill Book Company, Inc., 1925), 219.

11.Douglas M. Considine, Industrial Weighing (New York: Reinhold Publishing Corporation, 1948), 89.

12.Delaware, Lackawanna and Western List of Officers, Agents, Stations, Equipment, Facilities, Etc., 1927, 98. Lengths of scales were taken from the length of the live rails. The set of live rails still attached to the remains of the scale platform measure 51 1/2 feet, but this scale is clearly categorized as a fifty-foot scale in the station list.

13.Railway Engineering and Maintenance Cyclopedia, third edition (New York: Simmons-Boardman Publishing Company, 1929), 678; and American Railroad Association, "Specifications for the Manufacture and Installation of Railroad Track Scales," Proceedings (Chicago: American Railroad Association, November 19, 1919), 206.

14.D.L. & W. List, 63.

15.Droege, 226.

16.Wade, "Railway Track," (May 1914), 225.

17.Ralph W. Smith, Testing of Weighing Equipment (Washington, D.C.: National Bureau of Standards, 1945), 3-6.

18.Smith, 3-6.

19.Smith, 50.

20.Smith, 20; and Wade, "Railway Track," (May 1914), 228.

21.Smith, 49-50.

22.Wade, "Railway Track," (May 1914), 228.

23.Wade, "Railway Track," (May 1914), 222.

24.American Railroad Association, "Specifications," 213.

25.Smith, 51-2.

26.Leo MacLane, interview by Historic American Engineering Record team, Steamtown National Historic Site, Scranton, Pennsylvania, July 31, 1989.

27.Cyclopedia, 677.

28.American Railroad Association, "Specifications," 222.

29.American Railroad Association, "Specifications," 229-30; and Wade, "Railway Track," (May 1914), 223-5.

30.Wade, "Railway Track," (May 1914), 220-221.

31."Scale Test Car of the United States Bureau of Standards," Railway Age Gazette Vol. 55 (November 21, 1913), 985.

32.Wade, "Railway Track," (May 1914), 230.

33.Wade, "Railway Track," (June 1914), 385.

34.Cyclopedia, 680.

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